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(54) **METHOD FOR MANUFACTURING TOUCH PANEL**

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H05K 3/00 (2006.01)
G06F 3/042 (2006.01)
H01L 27/12 (2006.01)

(52) **U.S. Cl.**
CPC ***H05K 3/00*** (2013.01); *G06F 3/041* (2013.01); *G06F 3/042* (2013.01); *H01L 27/1255* (2013.01); *H05K 2203/308* (2013.01)

(58) **Field of Classification Search**
CPC H05K 3/00; H05K 2203/308; G06F 3/041; G06F 3/042; G06F 3/043; H01L 27/1255
USPC 257/435; 345/173
See application file for complete search history.

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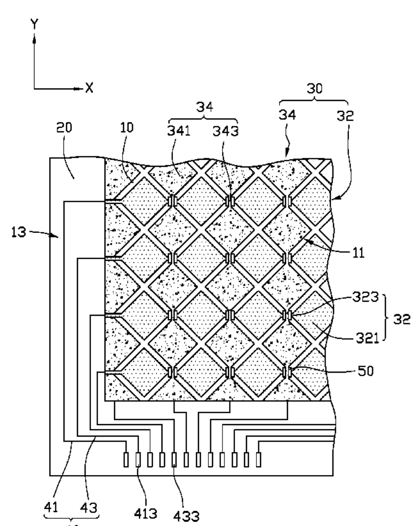
(57) **ABSTRACT**

A method for manufacturing a touch panel includes the following procedures. A first conductive layer and a shielding layer surrounding the first conductive layer are formed on a base plate. The first conductive layer is etched to form a plurality of first and second sensing pads alternatively arranged according to columns. The first sensing pads in a column along a first direction are electrically coupled to each other to form a first sensing electrode column. The second sensing pads in a column along a second direction are electrically coupled to each other to form a second sensing electrode column. A second conductive layer is formed on the shielding layer via an ink jet printing method, and is etched to form a plurality of first and second sensing lines to be respectively electrically coupled to the first and second sensing electrode columns.

14 Claims, 7 Drawing Sheets



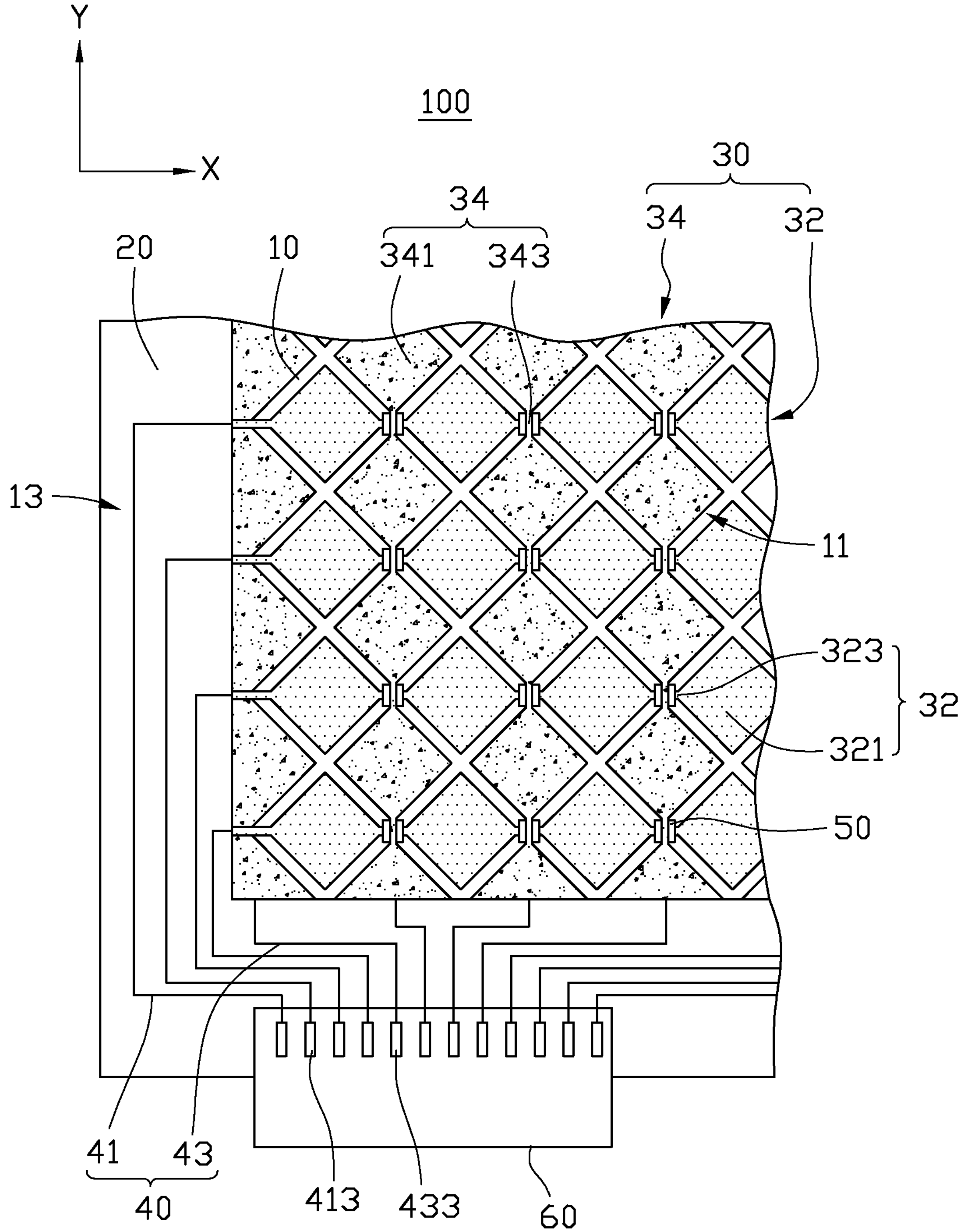

Y
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FIG. 1

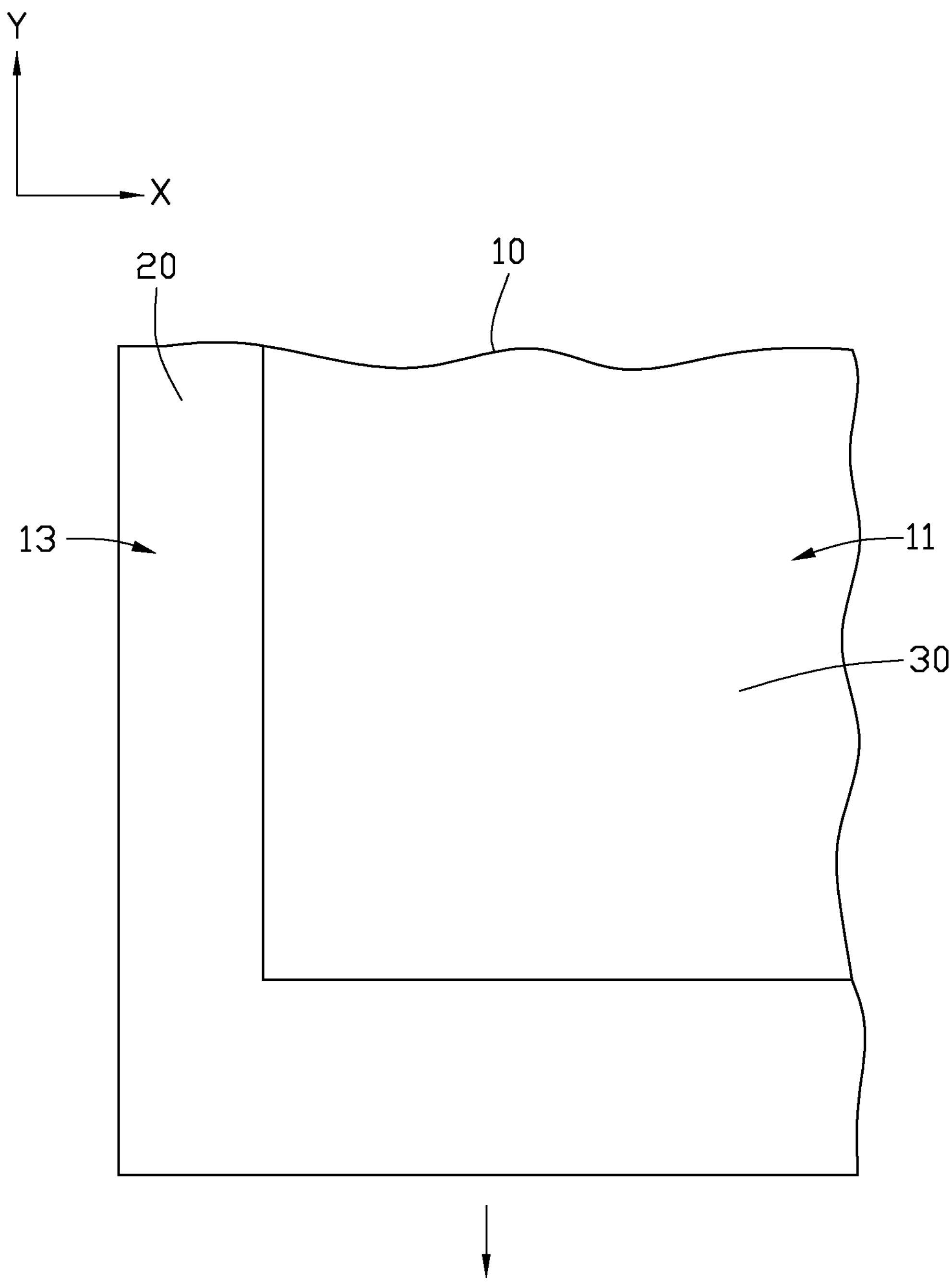

FIG. 2

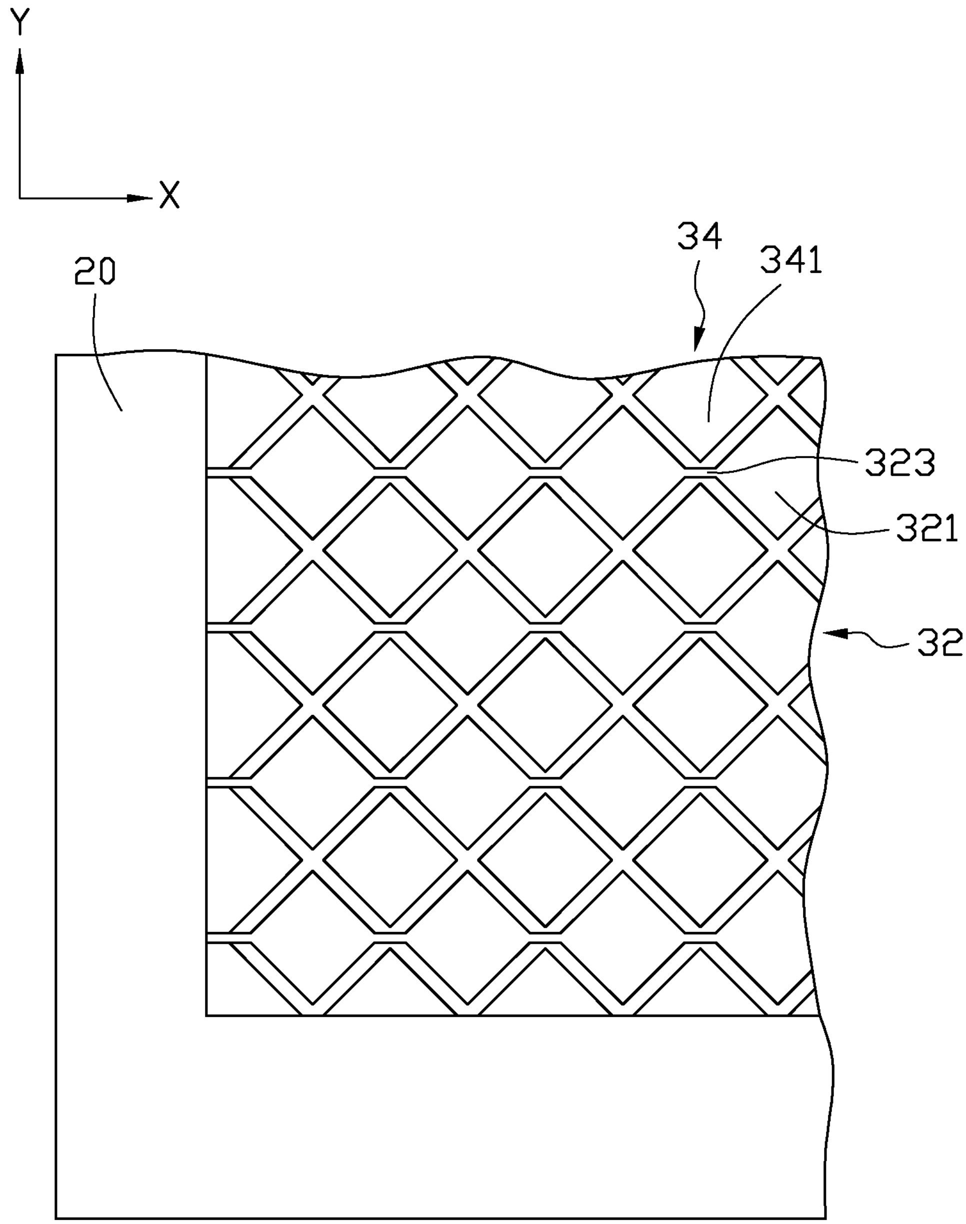

FIG. 3

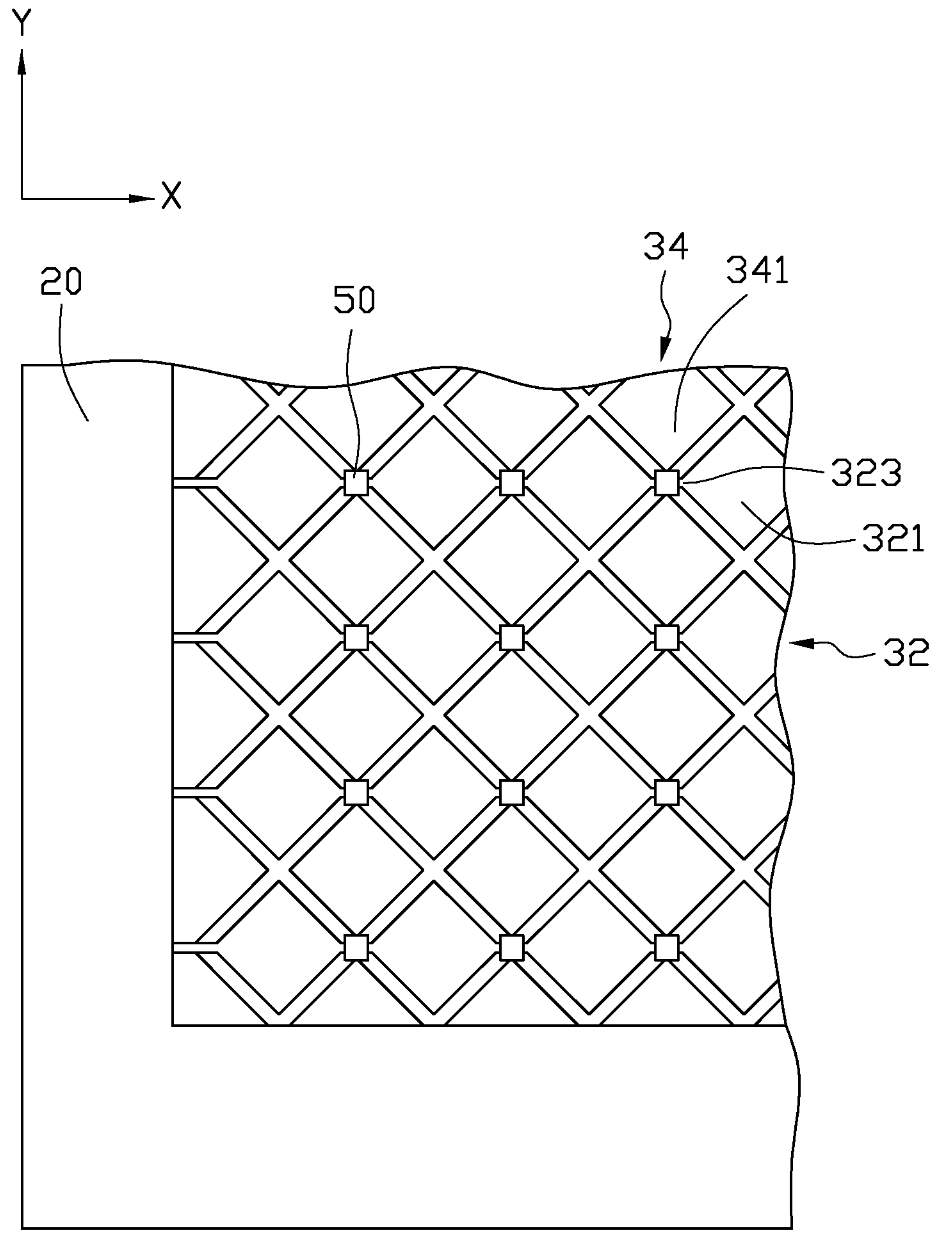

FIG. 4

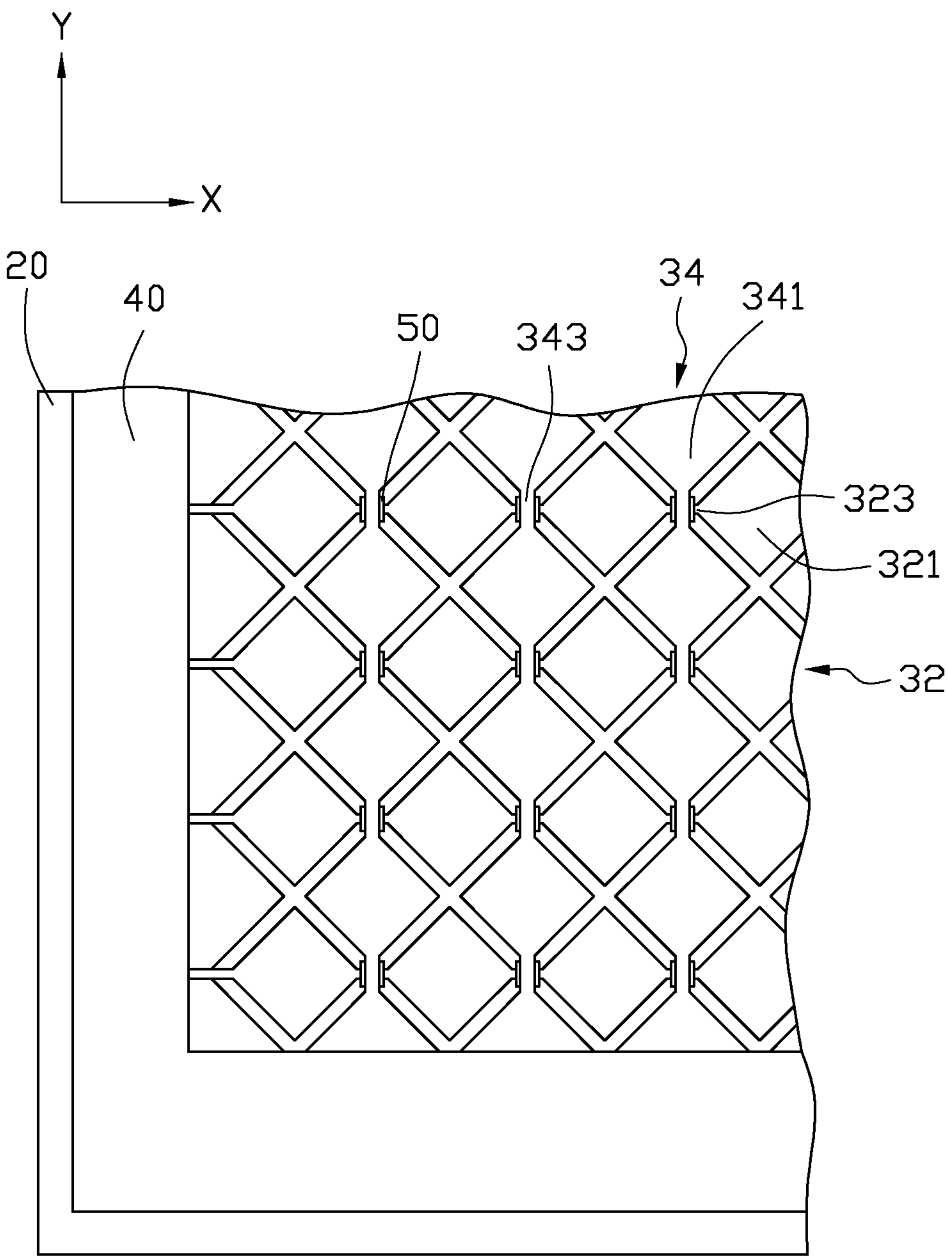

FIG. 5

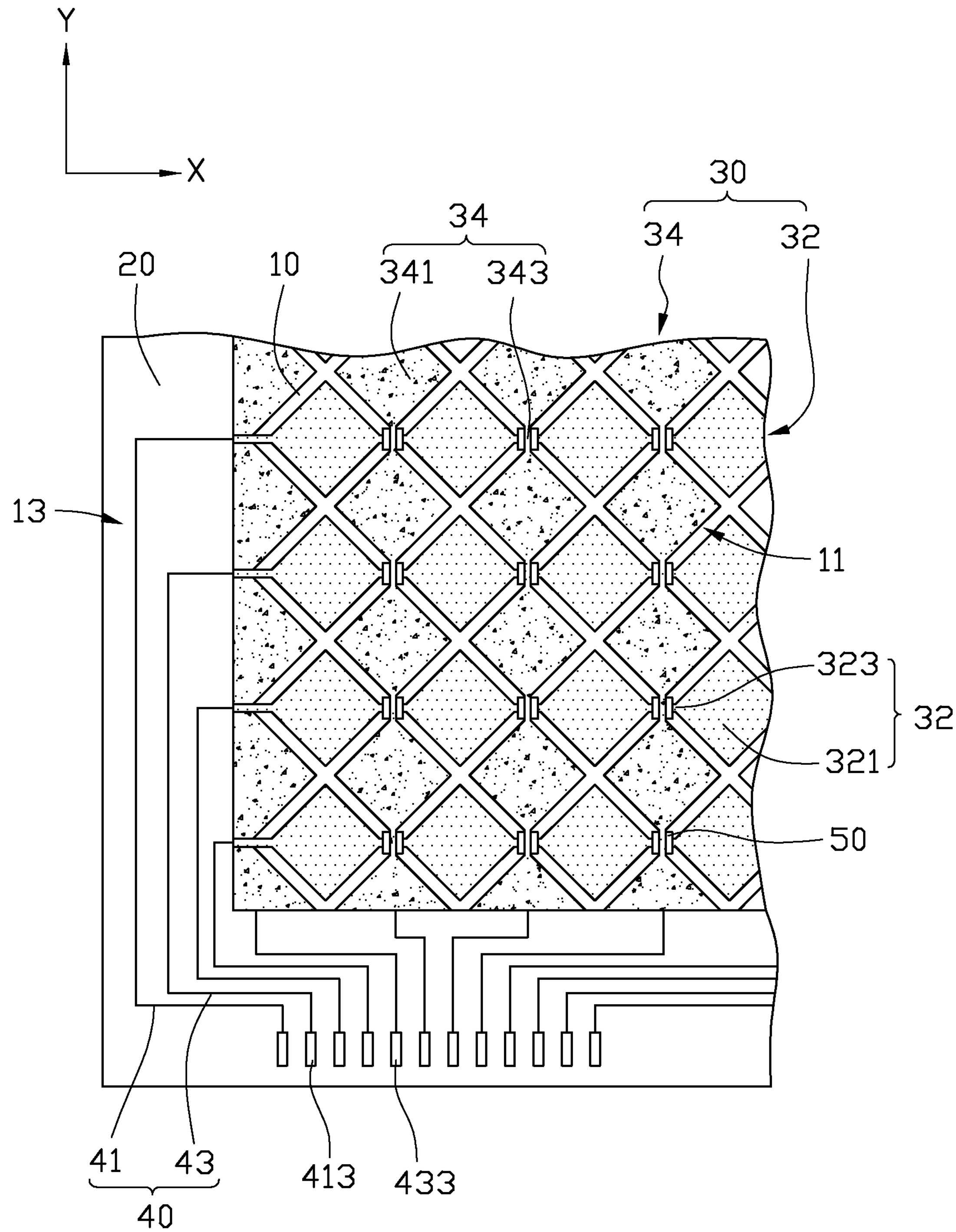

FIG. 6

700

Provide a base plate — 701

Form the first conductive layer and the shielding layer surrounding the first conductive layer on the base plate to completely cover the base plate — 702

Etch the first conductive layer to form the first sensing pads and the second sensing pads — 703

Form the insulated layers on the first sensing pads and the second sensing pads — 704

Form the second conductive layer on the shielding layer via an ink jet printing method, and form one bridge connector on each insulated layer to be electrically coupled to the two neighboring second sensing pads in the same column along the second direction Y via the ink jet printing method — 705

Etch the second conductive layer to form the first sensing lines and the second sensing lines by a laser processing method, and diminish the width of each bridge connector below 10μm via the laser processing method — 706

Attach the flexible printed circuit board to the first connecting pads and the second connecting pads — 707

FIG. 7

METHOD FOR MANUFACTURING TOUCH PANEL

FIELD

The subject matter herein generally relates to a method for manufacturing a touch panel, and in particular to a method for manufacturing a touch panel with a single conductive layer.

BACKGROUND

Touch panels are input devices that allow manual instruction to be input by touching the screen.

BRIEF DESCRIPTION OF THE DRAWINGS

Implementations of the present technology will now be described, by way of example only, with reference to the attached figures.

FIG. **1** is a top plan view of an embodiment of a part of a touch panel.

FIG. **2** illustrates a top view according to one example of a process for manufacturing the touch panel of FIG. **1**.

FIG. **3** illustrates a top view according to another example of a process for manufacturing the touch panel of FIG. **1**.

FIG. **4** illustrates a top view according to yet another example of a process for manufacturing the touch panel of FIG. **1**.

FIG. **5** illustrates a top view according to still another example of a process for manufacturing the touch panel of FIG. **1**.

FIG. **6** illustrates a top view according to one example of a process for manufacturing the touch panel of FIG. **1**.

FIG. **7** is a flowchart for manufacturing the touch panel of FIG. **1**.

DETAILED DESCRIPTION

It will be appreciated that for simplicity and clarity of illustration, where appropriate, reference numerals have been repeated among the different figures to indicate corresponding or analogous elements. In addition, numerous specific details are set forth in order to provide a thorough understanding of the embodiments described herein. However, it will be understood by those of ordinary skill in the art that the embodiments described herein can be practiced without these specific details. In other instances, methods, procedures and components have not been described in detail so as not to obscure the related relevant feature being described. Also, the description is not to be considered as limiting the scope of the embodiments described herein. The drawings are not necessarily to scale and the proportions of certain parts may be exaggerated to better illustrate details and features of the present disclosure.

Several definitions that apply throughout this disclosure will now be presented.

The term "coupled" is defined as connected, whether directly or indirectly through intervening components, and is not necessarily limited to physical connections. The connection can be such that the objects are permanently connected or releasably connected. The term "substantially" is defined to be essentially conforming to the particular dimension, shape, or other feature that the term modifies, such that the component need not be exact. For example, "substantially cylindrical" means that the object resembles a cylinder, but can have one or more deviations from a true cylinder. The term "comprising," when utilized, means "including, but not necessarily

limited to"; it specifically indicates open-ended inclusion or membership in the so-described combination, group, series and the like.

A method for manufacturing a touch panel can include: providing a base plate; forming a first conductive layer and a shielding layer surrounding the first conductive layer on the base plate to substantially completely cover the base plate; etching the first conductive layer to form a plurality of first sensing pads which are arranged according to columns along a first direction, the first sensing pads arranged in a column along the first direction being electrically coupled to each other to form a first sensing electrode column; etching the first conductive layer to form a plurality of second sensing pads which are arranged according to columns along a second direction intersecting the first direction, and forming one bridge connector between each two neighboring second sensing pads in a column along the second direction, the second sensing pads arranged in each column according the second direction having separate patterns and being electrically coupled to each other via the bridge connectors to form a second sensing electrode column; forming a second conductive layer on the shielding layer via an ink jet printing method, the second conductive layer at least partially covering the shielding layer; and etching the second conductive layer to form a plurality of first and second sensing lines separated from each other via a laser processing method, each first sensing line being electrically coupled to the corresponding one first sensing electrode column, and each second sensing line being electrically coupled to the corresponding one second sensing electrode column.

FIG. **1** illustrates an embodiment of a touch panel **100**. The touch panel **100** can include a base plate **10**, a shielding layer **20**, a first conductive layer **30**, a second conductive layer **40**, and a flexible printed circuit board (FPCB) **60**. The base plate **10** can include a display portion **11**, and a non-display portion **13** surrounding the display portion **11**. The shielding layer **20** can be formed on the non-display portion **13** to cover the non-display portion **13**. The first conductive layer **30** can be formed on the display portion **11**, and the edge of the first conductive layer **30** can overlap the edge of the shielding layer **20**, thus the conductive layer **30** and the shielding layer **20** can completely cover the base plate **10**. The second conductive layer **40** can be formed on the shielding layer **20**, and be electrically coupled to the first conductive layer **30**. The FPCB **60** can be positioned adjacent to a side of the base plate **10** and electrically coupled to the second conductive layer **40**. In at least one embodiment, the first conductive layer **30** cannot overlap the shielding layer **20**, so long as the conductive layer **30** and the shielding layer **20** can completely cover the base plate **10**.

The base plate **10** can be made of transparent insulation materials, such as transparent glass, quartz, or organic polymers. The shielding layer **20** can be made of black resin. In at least one embodiment, the material of the shielding layer **20** can be changed as needed.

The first conductive layer **30** can include a number of first sensing electrode columns **32** and a number of second sensing electrode columns **34** arranged as a matrix. The first sensing electrode columns **32** can intersect, and be insulated from the second sensing electrode columns **34**. The first sensing electrode columns **32** can be arranged along a first direction X. Each first sensing electrode column **32** can include a number of first sensing pads **321** and a number of connecting wires **323**. The first sensing pads **321** and the connecting wires **323** can be alternatively arranged along the first direction X and electrically coupled to each other in order. The second sensing electrode columns **34** can be arranged along a second direction Y which intersects the first direction X, and each second sensing electrode column **34** can include a number of second sensing pads **341** and a number of bridge connectors **343** which are alternatively arranged along the second direction Y and electrically coupled to each other in order. A number of insulated layers **50** can be sandwiched between the connecting wires **323** and the bridge connectors **343**, and each insulated layer **50** can be positioned on an intersectional portion of one connecting wire **323** and the corresponding one bridge connector **343**.

The first conductive layer **30** can be made of transparent conduction materials, such as indium tin oxide (ITO) or indium zinc oxide (IZO). The insulated layer **50** can be made of transparent organic materials, which are thermosetting or UV-curing, such as poly (**4** vinyl phenol), polyimide, aromatic ether, or aromatic hydrocarbon, for example. In at least one embodiment, the first conductive layer **30** can be made of metal, such as gold, silver, copper, aluminum, or molybdenum.

The shape of the second conductive layer **40** can be substantially a sector. The second conductive layer **40** can include a number of first sensing lines **41** and a number of second sensing lines **43** separated from the first sensing lines **41**. The first sensing lines **41** can be electrically coupled to the first sensing electrode columns **32**, respectively. Each first sensing line **41** can define a first connecting pad **413** on an end away from the corresponding first sensing electrode column **32**. The second sensing lines **43** can be electrically coupled to the second sensing electrode columns **34**, respectively. Each second sensing line **43** can define a second connecting pad **433** on an end away from the corresponding second sensing electrode column **34**. The number of first connecting pads **413** and the number of second connecting pads **433** can be located on a same side of the base plate **10**. In at least one embodiment, the first sensing lines **41** and the second sensing lines **43** can be made of materials with excellent conductivity, such as metal.

The FPCB **60** can be coated on, and electrically coupled to the first connecting pads **413** and the second connecting pads **433**, thus the FPCB **60** can be electrically coupled to the first sensing electrode columns **32** and the second sensing electrode columns **34** via the first sensing lines **41** and the second sensing lines **43**.

FIGS. **2** to **7** illustrate the process and method for manufacturing the touch panel in accordance with an example embodiment. Referring to FIG. **7**, a flow chart is presented in accordance with an example embodiment. The method **700** is provided by way of example, as there are a variety of ways to carry out the method. The method **700** described below can be carried out using the configurations illustrated in FIGS. **2-6**, for example, and various elements of these figures are referenced in explaining example method **700**. Each block shown in FIG. **7** represents one or more processes, methods or subroutines, carried out in the example method **700**. Furthermore, the illustrated order of blocks is by example only and the order of the blocks can change according to the present disclosure. Additional blocks may be added or fewer blocks may be utilized, without departing from this disclosure. The example method **700** for manufacturing the touch panel can begin at block **701**.

At block **701**, a base plate is provided. In at least one embodiment, the base plate **10** can be made of transparent insulation materials, such as transparent glass, quartz, or organic polymers.

At block **702**, the first conductive layer and the shielding layer are formed together on the base plate to cover the base plate, and the shielding layer surrounds the first conductive layer.

In at least one embodiment, the first conductive layer **30** can be coated on the display portion **11** of the base plate **10** by a sputtering coating method, the shielding layer **20** can be formed on and cover the non-display portion **13**. The shielding layer **20** can be made of black resin.

At block **703**, the first sensing pads and the second sensing pads are formed via etching the first conductive layer.

The first sensing pads **321** and the second sensing pads **341** can be arranged as a matrix, insulated from each other, and alternatively arranged according to columns. The connecting wires **323** can be formed via etching parts of the first conductive layer **30** located between each two adjacent first sensing pads **321** in the same column along the first direction X, thus the first sensing pads **321** in the same column along the first direction X can be electrically coupled to each other via the first connecting wires **323**. The first sensing pads **321** in the same column along the second direction Y can be insulated from each other. The second sensing pads **341** in the same column along the second direction Y can be formed in separate patterns, thus the second sensing pads **341** can be insulated from each other.

At block **704**, the insulated layers are patterned on the first sensing pads and the second sensing pads.

Each insulated layer **50** can be located on a portion of each two neighboring second sensing pads **341** in a column along the second direction Y, and a portion of each two first sensing pads **321** positioned adjacent to the two neighboring second sensing pads **341**. The insulated layers **50** can be formed via an ink jet printing method. In at least one embodiment, the insulated layers **50** can be attached to the first sensing pads **32** and the second sensing pads **34**.

At block **705**, the second conductive layer is formed on the shielding layer via an ink jet printing method, and one bridge connector is formed on each insulated layer and electrically coupled to the two neighboring second sensing pads in the same column along the second direction Y via the ink jet printing method.

The second conductive layer **40** and the bridge connectors **343** can both be composed conductive nanoparticles of ink doped with silver. The second conductive layer **40** can be substantially fan-shaped, and can cover the shielding layer **20**, and the width of each bridge connector **343** can be about 30 μm to 50 μm. In at least one embodiment, the second conductive layer **40**, and the bridge connectors **343** can be made of ink doped with gold or copper nanoparticles. In at least one embodiment, the bridge connectors **343** can be formed after the step of forming the second conductive. In at least one embodiment, the step of forming the bridge connectors **343** can be omitted, and the bridge connectors **343** can be made of metal wires covered with insulated film to directly interconnect with each two neighboring second sensing pads **341**.

At block **706**, the first sensing lines and the second sensing lines are formed via etching the second conductive layer by a laser processing method and the width of each bridge connector is reduced below 10 μm via the laser processing method.

The first sensing lines **41** can be separated from the second sensing lines **43** to provide an insulation property. The first sensing lines **41** can be spaced a predetermined distance from each other to provide an insulation property. The second sensing lines **43** can be spaced a predetermined distance from each other to provide an insulation property. Each first sensing line **41** can be coupled to the corresponding first sensing pads **321** in a same column. Each second sensing line **43** can be coupled to the corresponding second sensing pads **341** in a same column. A laser device (not shown) can emit laser beams to parts of the second conductive layer **40** and the edge of each bridge connector **343**. When a power density of the laser beams is more than a threshold power density of the second conductive layer **40**, the parts of the second conductive layer **40** can be vaporized by the laser beams. In this way, the first sensing lines **41** and the second sensing lines **43** can be formed, and the width of each conductive connector **70** can be reduced. The laser device can emit continuous laser beams to form the first sensing lines **41** and the second sensing lines **43**, and to diminish the widths of the conductive connectors **70**, and the wave length of the laser can be about 1064 nanometers. In at least one embodiment, the laser device can emit pulse laser beams to form the first sensing lines **41** and the second sensing lines **43**, and diminish the widths of the conductive connectors **70**, and the wave length of the laser is not limited to above.

At block **707**, the flexible printed circuit board is attached to the first connecting pads of the first sensing lines and the second connecting pads of the second sensing lines.

In at least one embodiment, the method can include a curing step after forming the first conductive layer **30**, forming the insulated layer **50**, forming the bridge connectors **343**, or forming the second conductive layer **40**, respectively. The corresponding film can be cured by one or more methods selected from the group consisting of room temperature curing, high temperature curing, and ultraviolet curing.

While the present disclosure has been described with reference to particular embodiments, the description is illustrative of the disclosure and is not to be construed as limiting the disclosure. Therefore, those of ordinary skill in the art can make various modifications to the embodiments without departing from the scope of the disclosure, as defined by the appended claims.

What is claimed is:

1. A method for manufacturing a touch panel, the method comprising:

providing a base plate;

forming a first conductive layer and a shielding layer surrounding the first conductive layer on the base plate to substantially completely cover the base plate;

etching the first conductive layer to form a plurality of first sensing pads which are arranged according to columns along a first direction, the first sensing pads arranged in a column along the first direction being electrically coupled to each other to form a first sensing electrode column;

etching the first conductive layer to form a plurality of second sensing pads which are arranged according to columns along a second direction intersecting the first direction, and forming one bridge connector between each two neighboring second sensing pads in a column along the second direction, the second sensing pads arranged in each column according the second direction having separate patterns and being electrically coupled to each other via the bridge connectors to form a second sensing electrode column;

forming a second conductive layer on the shielding layer via an ink jet printing method, the second conductive layer at least partially covering the shielding layer; and

etching the second conductive layer to form a plurality of first and second sensing lines separated from each other via a laser processing method, each first sensing line being electrically coupled to the corresponding one first sensing electrode column, and each second sensing line being electrically coupled to the corresponding one second sensing electrode column.

2. The method of claim **1**, further comprising a step before the step of forming the bridge connectors: forming a plurality of insulated layers on the plurality of first and second sensing pads, each insulated layer overlapping a portion of each two neighboring second sensing pads arranged in a column along the second direction and a portion of each two first sensing pads positioned adjacent to the two neighboring sensing pads, and the bridge connectors are formed on the plurality of insulated layers.

3. The method of claim **2**, wherein the plurality of insulated layers are formed by the ink jet printing method.

4. The method of claim **2**, wherein the bridge connectors are formed by the ink jet method, and the width of each conductive connector after the step of forming the conductive connectors is in a range from about 30 μm to about 50 μm.

5. The method of claim **4**, further comprising a step during the step of forming the plurality of first and second sensing lines, the step comprising: diminishing the widths of the plurality of edge connectors below 10 μm via the laser processing method.

6. The method of claim **1**, wherein continuous laser beams are employed in the step of forming the plurality of first and second sensing lines to form the plurality of first and second sensing lines.

7. The method of claim **1**, wherein plus laser beams are employed in the step of forming the plurality of first and second sensing lines to form the plurality of first and second sensing lines.

8. The method of claim **1**, wherein a laser with a wave length of 1064 nanometers is employed in the step of forming the plurality of first and second sensing lines to form the plurality of first and second sensing lines.

9. The method of claim **1**, further comprising a step after the step of forming the first conductive layer, the step comprising: solidifying the first conductive layer.

10. The method of claim **9**, wherein the first conductive layer is solidified by one or more methods selected from the group consisting of a method of room temperature curing, a method of high temperature curing, and a method of ultraviolet curing.

11. The method of claim **1**, further comprising a step after the step of forming the second conductive layer, the step comprising: solidifying the second conductive layer.

12. The method of claim **11**, wherein the second conductive layer is solidified by one or more methods selected from the group consisting of a method of room temperature curing, a method of high temperature curing, and a method of ultraviolet curing.

13. The method of claim **1**, wherein the second conductive layer is made of one or more materials selected from the group consisting of ink doped with silver nanoparticles, ink doped with gold nanoparticles, and ink doped with copper nanoparticles.

14. The method of claim **1**, wherein the first conductive layer is formed by a sputtering coating method.

* * * * *